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## An Application of Game Refinement Theory in Popular Activities

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With the development of game development, game theories have sprung up in recent years. Games are intensively studied for their entertaining or educational functions, or the characteristics of game itself. However, the existing theories are mainly about traditional games. Popular games are in lack of scientific study because of their variability and complexity. Moreover, there are very few research about crossing field between game and art, though art is always concerned a pastime way. Therefore, I choose Mafia game and Music as two targets of popular activities, to fill the blank within entertainment field. In this study, I am focusing on the average length and outcome of games. Through the method of game refinement theory, progress model is built, and game acceleration and risk ratio can be calculated. In Mafia game, we suggested that for the citizens group, sheriff is much more important than doctor from the viewpoint of game balancing. The balance setting with  $N = 12$ ,  $MFG(12, m, s, d)$  is the players number with  $m = 5, s = 1, d = 2$  or  $m = 4, s = 1, d = 1$  while minimizing the difference of winning ratio between mafia and citizen groups. Also, the acceleration of game will reduce as the number of players increases. This may imply that Mafia game would become boring as the players number becomes too large.  $MFG(N, m, s, d)$  can be played reasonably with  $N \in \{14, 15, 16\}$ ,  $m \in \{5, 6\}$ ,  $s = 1$  and  $d \in \{1, 2\}$ . In particular,  $MFG(15, 5, 1, 1)$  or  $MFG(15, 6, 1, 2)$  is the best under the assumption that its GR value is within the sophisticated zone. Moreover, the level of players affects game balance and game sophistication. For example, mafia would dominate citizens if all players are weak, which implies the decreasing in game sophistication. Besides, the result of game refinement value and risk ratio of music shows that game and art shares common factor in acceleration (0.07 - 0.08). Yet different genres of music differ from each other. The Out-of-Japan music is unexpectedly like Enka, with a "Zone" value in acceleration. It implies a proper length in general. While Japanese popular music and Rock has a lower GR value. which means they are more simple to listeners.